Dr. Ernest Steinauer, Chair
Nantucket Conservation Commission
4 Bathing Beach Road
Nantucket MA 02554

August 8, 2013

Re: NOI, Baxter Road and Sconset Bluff Storm Damage Prevention Project

Submitted by: Robert S. Young, PhD, PG
Director, Program for the Study of Developed Shorelines

Please consider the following comments as you evaluate the permitting of the Siasconset (Sconset) Bluff Storm Damage Prevention Project. I am a coastal geologist with 25 years of experience in coastal science, coastal management, and the evaluation of coastal engineering design. I have international experience along with significant experience locally in Massachusetts. I am currently working with the National Park Service to develop detailed coastal storm and sea-level rise adaptation plans for Cape Cod National Seashore and Boston Harbor Islands National Recreation Area.

I would like to begin by providing a bit of background regarding the coastal management concerns when constructing large-scale erosion control structures like the one proposed for Sconset Bluff. Finally, I will have a list of additional concerns and thoughts regarding the project and my experience with others around the country.

How do seawalls, bulkheads, and revetments impact beaches?

Seawalls, revetments, and bulkheads are shore-parallel structures used to protect the land behind them. Regardless of the specific name used, they all perform the same function; I thus refer to structures like that proposed for Sconset as "seawalls". There is clear, scientific consensus that seawalls, when placed on an eroding or retreating beach will cause that beach to narrow and eventually disappear. The negative effects of seawalls on beaches are so clear that they have been included in textbooks (e.g. Pinet, Nordtsrom) and have been the subject of numerous scientific articles (e.g. Hall and Pilkey, 1991; Griggs, 1991). The United States Army Corps of Engineers recognized these problems in a 1981 Technical Note entitled "Seawalls Their Applications and Limitations" (CETN-III-8):

> Seawalls protect only the land immediately behind them, offering no protection to fronting beaches. Also on a receding shoreline, recession will continue on the adjacent shore and may even be accelerated by the construction of a seawall. If nearby beaches were being supplied with sand by the erosion of the area protected by a new seawall, the beaches will be starved and will experience increased erosion. Therefore, if a beach is to be retained adjacent to a seawall, additional structures may be necessary.

Hall and Pilkey (1991) point out that there are three types of erosion associated with a sea-walled beach: placement loss, passive erosion and active erosion. *Placement loss* occurs when a shore parallel structure is placed seaward of the dune, bluff, cliff or first line of vegetation, thus immediately reducing the width of the beach (Fig. 1). Rocks placed on the beach during the construction of any rock revetment such as that proposed for Sconset will result in an immediate loss of the upper portion of that beach. Thus, the project will likely result in immediate placement loss.

Fig. 1 Placement loss resulting from a seawall at Sandbridge, VA.

Passive erosion occurs on an eroding or retreating beach when the dune line or upper beach is armored or replaced by a permanent hard stabilization structure, thereby causing the landward boundary of the beach to have a fixed location (Fig. 2-4). In effect, a "line in the sand has been drawn" beyond which the beach will not be allowed to naturally migrate. The problem is that building a seawall on a chronically retreating shoreline does not halt the erosion or shoreline movement. It simply creates a landward boundary for the ocean shoreline to run into. On an eroding shore (and the vast majority of the sand beaches in the US are eroding), the beach will simply narrow in front of the seawall until it disappears. It should be made very clear that on any sandy shoreline experiencing shoreline retreat, erosion does not destroy the beach. It simply moves the beach landward. However, placing an immovable object such as a large building or a seawall in the way of that retreat will remove the beach, and along with it, any public easement or access. It is this fundamental understanding of passive erosion's effects on beaches that has caused many states to ban seawalls, revetments and bulkheads on ocean shorelines. Engineers typically do not consider passive erosion when planning for the protection of coastal property, assuming that the goal is to protect an investment, and not the beach. Once the beach (and therefore the public easement) is gone, the only way to restore it is through constant replacement of the sand through beach nourishment. This lesson has been

learned the hard way on many of our nation's most important beaches.

Pre-determining the amount of sand that will be required to protect the wall from becoming undermined and providing an adequate beach for public use and egress is difficult. One cannot simply assume that the sand placed in front of the wall will erode at the same rate as the beach/bluff did before the wall was built. Beach fill projects typically erode faster than natural sand, and the wall can completely change local coastal processes, often accelerating the loss of beach sand during storm event when large waves are engaging the wall. What is clear is this, seawalls and revetments will require frequent beach nourishment projects in perpetuity. Because it would be built on a retreating coastline, the Sconset revetment will result in passive loss of the beach. The nourishment plan to mitigate this passive beach loss should be viewed as completely experimental, as there is no track record of beach nourishment at this location. The long-term costs and sand volumes required may far exceed the ability of the project sponsors to ensure an adequate sandy beach for public use and protection of the revetment. If constructed, the project should include well-defined metrics for sandy beach maintenance. Monitoring of the beach for these metrics should be carried out by an independent third party.

Fig. 2: Passive erosion at Sea Bright, NJ before beach nourishment.

Fig 3: Miami Beach after years of passive erosion (left), and after massive beach renourishment.

Fig. 4: Passive erosion at Galveston, TX

Finally, *Active erosion* defines any process that accelerates erosion due to the presence of seawall, bulkhead, or revetment. It involves the redistribution of sediment supply to a

beach and/or any modification of shore zone processes due to the seawall. There are three ways in which a seawall can actively degrade a beach: wave reflection and scour, end effect, and reduction in sediment supplied to the beach from the dunes and upland.

There has been a long and vigorous debate within the scientific and engineering community as to whether or not seawalls enhance the erosion of the beaches in front of them through wave reflection and increased scour. Many scientists have argued that this is an important process, while many engineers have been skeptical. In the long run, this process is probably less important to beach loss than simple passive erosion over time. The other two processes of active erosion are more clearly recognized by all parties. They are also significant because they have an immediate impact on neighboring properties.

Fig. 5: End effect from a bulkhead, Southampton, NY

The end effect is the result of waves diffracting around the edges of the wall during storms or high water events. It results in a clear increase in erosion at the margins of the

seawall (Fig. 5). The end effect often results in the construction of another seawall on the adjacent property in order to protect it from the increased erosion. End effects have results in numerous neighbor-on-neighbor lawsuits on beaches around the US.

In addition to the end effect, seawalls eliminate the natural sediment supply that would come to the beach through erosion of the dunes and upland behind the wall. Retreating beaches can maintain themselves by receiving sediment that is moving alongshore and by receiving sediment from the dunes and bluffs as the beach erodes. Seawalls seal off the latter as a source of sediment. This sediment would naturally enter the longshore sediment transport system and move down the coast to feed neighboring beaches. As more and more seawalls are constructed, this source of sediment is eliminated and all of the beaches suffer. This serves to enhance the end effect at the small scale and can lead to large-scale increases in erosion for larger or multiple seawalls. The length and scale of the proposed revetment for Sconset Bluff is clearly large enough to have significant downdrift impacts. The impacts may even extend in both directions, because Siasconset is likely at a "nodal point" in the sediment transport system, where sand contributed by bluff erosion moves both to the north and to the south/west. This is similar to the ocean-facing shoreline of Outer Cape Cod between Orleans and Wellfleet, where sediment is transported to the north towards Provincetown, and to the south towards Monomoy Island. The proposed Sconset revetment will also result in active erosion of the coastal zone.

In summary, there is no doubt that choosing to protect coastal property with shore-parallel structures like seawalls, bulkheads, and revetments will ultimately lead to the destruction of the dry beach and any public easement held on that beach. It is for these reasons that many states and localities have chosen to ban the construction of seawalls.

Banning seawalls in legislation, statute and rule:

It is instructive to examine the justification used by state legislatures when seeking to regulate seawall construction in a desire to maintain the public's interest in the beach. These restrictions occur in states with a wide variety of political leanings and are typically based on a desire to protect the beach as an economic resource and to protect long-standing public beach access, rather than environmental concerns (although environmental concerns are important as well).

The State of South Carolina banned seawalls with their comprehensive Beachfront Management Act in 1987. Much of the impetus for this ban was the fact that the vast majority of the high tide beach had disappeared from the state's most important tourist destination, Myrtle Beach and the Grand Strand. The ban was reaffirmed during Hurricane Hugo in 1989 when many of the "protective" seawalls failed or were over-topped by the storm surge. The author of this memorandum currently sits on the South Carolina Blue Ribbon Commission for Shoreline change. A largely legislative commission charged with reviewing the almost 25-year old Beachfront Management Act. There was no discussion about revoking the seawall ban. It has, by all accounts, served

the state well. The Act states:

> **SECTION 48-39-250.** Legislative findings regarding the coastal beach/dune system.
>
> (5) The use of armoring in the form of hard erosion control devices such as seawalls, bulkheads, and rip-rap to protect erosion-threatened structures adjacent to the beach has not proven effective. These armoring devices have given a false sense of security to beachfront property owners. In reality, these hard structures, in many instances, have increased the vulnerability of beachfront property to damage from wind and waves while contributing to the deterioration and loss of the dry sand beach which is so important to the tourism industry.
>
> (6) Erosion is a natural process which becomes a significant problem for man only when structures are erected in close proximity to the beach/dune system. It is in both the public and private interests to afford the beach/dune system space to accrete and erode in its natural cycle. This space can be provided only by discouraging new construction in close proximity to the beach/dune system and encouraging those who have erected structures too close to the system to retreat from it.

The State of North Carolina banned seawalls, and all coastal engineering structures two years earlier in 1985 for similar reasons. Since the ban, only one seawall has been constructed to protect a Civil War Era Fort. And, that seawall has completely eliminated the beach in front of it and caused significant adjacent erosion. The reasoning for the ban is short and straightforward:

> 15A NCAC 07H .0308 SPECIFIC USE STANDARDS FOR OCEAN HAZARD AREAS
> (a) Ocean Shoreline Erosion Control Activities:
> (1) Use Standards Applicable to all Erosion Control Activities:
> (A) All oceanfront erosion response activities shall be consistent with the general policy statements in 15A NCAC 07M .0200.
> (B) Permanent erosion control structures may cause significant adverse impacts on the value and enjoyment of adjacent properties or public access to and use of the ocean beach, and, therefore, are prohibited. Such structures include bulkheads, seawalls, revetments, jetties, groins and breakwaters.

Specific notes on the Baxter Road and Sconset Bluff Storm Damage Prevention Project

1) It must be clearly acknowledged that this large rock revetment will eliminate any beach fronting the bluff. In addition, the structure will deprive downdrift beaches of sediment increasing neighboring rates of erosion while holding the bluff in place.

2) Mitigation will be required to maintain a beach in front of the revetment and to keep the toe of the revetment out of the sea. Mitigation will also be required to add sand to downdrift beaches. Predicting the amount of sand required on an annual basis is difficult because the need will be determined by storm frequency along with any local changes to sediment supply and dynamics caused by the structure.

3) It has been my experience that mitigation requirements based on any clause requiring that the structure must be demonstrably proven to be the cause of increased erosion or the cause of a downdrift sand deficit are problematic. Proving an increase in erosion on a shoreline is straightforward. Demonstrating direct, indisputable cause and effect in a court of law is almost impossible. Coastal monitoring plans simply can't account for that level of detail, and monitoring the impacts of storms is particularly problematic. In my opinion, one cannot assume that mitigation sand will be ordered for downdrift property owners if it MUST be demonstrated that the revetment is the primary cause (even if the revetment IS the primary cause).

4) It is my professional opinion that the project is under-designed for the wave climate and exposure of the bluff. The toe of the wall is not deep enough to account for the variability in the beach profile elevation along such a dynamic shoreline. The narrow beach in front of the wall will also make the structure vulnerable. This is a project on the scale of those typically carried out by the Unites States Army Corps of Engineers, which are predicated upon a substantial federal interest in property preservation. Keeping that beach and those rocks in place given the extreme wave climate will be impossible, over the long run. In fact, I think that it will be quite a challenge to transfer the rocks from a barge to the shore during project construction.

5) Another cautionary note from my experience elsewhere in the US. Once projects like this go in, they never come out. Removing them is more expensive than placing them. To my knowledge, no structure of this magnitude has ever been removed or ordered to be removed. If the structure is built and causes harm or fails, I simply don't believe it will ever be removed. I have never seen it happen anywhere else. What is more likely is that if the structure fails, it will be "improved." This means it will be enlarged or extended at someone's expense.

6) Many very bad coastal engineering projects have been permitted during emergency orders, general orders, or in other such situations. I recently watched the construction of the largest rock revetment ever constructed to protect one home. The structure was built with almost no review on Long Island following Hurricane Sandy. Local Town Trustees opposed it, but were powerless to stop it. The structure would never have been permitted by New York DEC during the standard permitting process. I urge you to take your time in reviewing this request. If this is an emergency, then almost every other shoreline in the US is

experiencing emergency conditions. A structure of this magnitude should not be permitted or evaluated hastily.

7) I understand that Sconset Bluff property owners have tried many options for slowing the rate of erosion along the bluff. It is to their credit that they did not move straight to the nuclear option of massive hard stabilization. I sympathize with their frustration. Normally, we would recommend beach nourishment; especially since property owners would be willing to cover the majority of the costs. It is unfortunate that large scale beach nourishment is not an option here due to concerns about fisheries impacts. These kinds of concerns have halted beach nourishment projects in other areas as well (e.g. Palm Beach County, FL).

8) It is my professional opinion that the logical next step is not the construction of a large rock revetment, but rather, the development of a long-term plan for getting critical infrastructure and threatened property out of harms way. This is a truly long-term solution that one can walk away from. The proposed Baxter Road and Sconset Bluff Storm Damage Prevention Project will require managing, monitoring, and funding forever.

References:

Griggs, G. B., Tait, J. F., Scott, K., and Plant, N. **(1991).** 'The interaction of seawalls and beaches: Four years of field monitoring in Monterey Bay, California. *Proc. Coastal Sediments '91*. Amer. Soc. Civil Engineers, Seattle, **1 871-1885.**

Hall, M.J. and Pilkey, O.H. 1991. Effects of hard stabilization on dry beach width for New Jersey. Journal of Coastal Research, 7 (3), 771-785.

United States Army Corps of Engineers. 1981. Seawalls Their Applications and Limitations (CETN-III-8)

Robert S. Young, PhD (Licensed Professional Geologist in NC, SC, FL)
Director, Program for the Study of Developed Shorelines
Professor, Coastal Geology
Western Carolina University
Belk 294
Cullowhee, NC 28723
828-227-3822, FAX 828-227-7163
ryoung@email.wcu.edu
psds.wcu.edu